

## SYSTEMATICS, DISTRIBUTION, AND NOMENCLATURE OF THE POLYMORPHIC *VACCINIUM ANGUSTIFOLIUM*

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Since 1950 and 1952, when Fernald and Gleason respectively published their floras of northeastern United States and adjacent Canada, the taxonomic treatment of the lowbush blueberry has been the centre of considerable controversy. While Fernald recognized but one polymorphic species, Gleason followed Camp's (1945) treatment and recognized three distinct entities *viz.* *Vaccinium angustifolium* Aiton, *V. brittonii* Porter ex Bicknell, and *V. lamarckii* Camp. In 1942, Camp had stated that *V. angustifolium* is the basic diploid ( $2n = 24$ ) of this trilogy, having a distribution centered in the eastern subarctic of North America and existing only as relic populations in the southern parts of its range. He considered *V. lamarckii* to be a tetraploid ( $2n = 48$ ) derived from *V. angustifolium* (Camp, 1945: 234), and *V. brittonii* another tetraploid of unknown affinity but possibly a mutant derived from *V. lamarckii* (Camp, 1945: 237).

However, Camp's evidence for these generalizations is meagre: he assumed that *Vaccinium angustifolium* was a diploid species on the basis of a single count reported by Darrow *et al.* (1944). Furthermore, no supporting voucher specimen could be located. The material for this count might have come from the White Mountains in which case *V. boreale* Hall & Aalders cannot be ruled out. Camp argued that *V. boreale* was merely a stunted form of *V. angustifolium* although it had previously been recognized at the varietal level by both Wood (1861) and Gray (1848). Recently, the taxonomic status of this taxon has been clarified (Vander Kloet, 1977).

Subsequent cytological studies by Hall and Aalders (1961) and Whitton (1964) of the lowbush blueberry in eastern Canada and Maine respectively showed that *Vaccinium angustifolium*, *V. brittonii* and *V. lamarckii* were consistently tetraploid ( $2n = 48$ ).

I have also tried to find a diploid *Vaccinium angustifolium* in Ontario where I took clonal material as well as open pollinated seeds from plants which fell within Camp's (1945) morphological description of *V. angustifolium*, i.e. colonies 10–15 cm high, twigs of the current season green, abaxial surface of leaves glabrous or with

a line of pubescence along the midvein, less than 10 mm wide and 30 mm long, margin sharply serrate, corolla cylindraceous, 3–5 mm long and fruit bright blue, glaucous, 5–7 mm in diameter. However, these plants (parents and progeny) were all tetraploid (Bent & Vander Kloet, 1976; Hersey & Vander Kloet, 1976).

Additional experimental analysis by Aalders and Hall (1963) demonstrated that the diagnostic features of *Vaccinium brittonii* (i.e. glaucous leaves and twigs, which serve to distinguish it from *V. angustifolium*) are controlled in part by a semidominant gene and in part by exposure to sunlight.

Finally, numerical studies of *Vaccinium* sect. *Cyanococcus* in northeastern Ontario by Smith (1969) and in eastern Ontario and adjacent New York by Vander Kloet (1972) failed to detect any substantive morphological discontinuity among *V. angustifolium*, *V. lamarckii* and *V. brittonii*.

While the data, cited above, have not corroborated Camp's hypothesis that the lowbush blueberry complex is composed of three biological entities ("morphs" in the following discussion), neither have they weakened it substantially; therefore, the purpose of this paper is to bring evidence against the hypothesis by showing (1) that the three morphs cross-pollinate freely in the field; (2) that the three morphs do not breed true in the field; (3) that the three morphs frequently intermingle at each site; (4) that the three morphs flower at the same time at each site; and (5) that greenhouse grown plants from the three morphs interbreed freely with one another. From this evidence and the studies cited above the conclusion is reached that reduction of these three morphs to a single species, *Vaccinium angustifolium* Aiton, is appropriate.

#### METHODS AND MATERIALS

Sampling space was arbitrarily restricted to 40 blueberry habitats located within 23 regions scattered throughout eastern North America (for details of geographical location see APPENDIX I.) At each of the 40 sites a minimum of one hectare was systematically searched and a few mature twigs from each different phenotype of *Vaccinium* sect. *Cyanococcus* were collected and dried<sup>1</sup>. In addition to taking soil samples and making ecological and habitat notes for each

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<sup>1</sup>Voucher specimens in ACAD. Acronyms follow *Index Herbariorum*, Holmgren & Keuken (1974).

collection, a few, usually five, ripe berries were harvested so that small, random populations could be reared under glass for later analysis of potential gene exchange within and between the different morphological groups.

In order to assess the frequency of each species at a given site, transects were run through nine lowbush blueberry habitats (marked with an asterisk in APPENDIX I). At each of the nine sites, 50-metre tapes were laid down 20 metres apart and at each 10 metre mark the *Vaccinium* species, if any, touching the mark or falling within a 10 cm diameter circle centered on the mark was recorded.

To follow flowering, pollination, and fruiting a minimum of 5 colonies was permanently marked in 1970 at Kaladar, Ontario; at Chaffey's Locks, Ontario; at Rock Dunder, Morton, Ontario; at Mt. Fitzsimmons, Ivy Lea, Ontario; Well's Island, Jefferson County, New York; and Biorachan Road, West Branch of River John, Nova Scotia. Observations have been made from 1970 to 1975 not only on these permanent colonies but also on adjacent colonies.

Next, the dried specimens were scored for the following four features: plant height (from field data); mean leaf width; type of leaf margin (entire or serrate); and type of abaxial leaf indumentum (glaucous, glabrous, or pubescent). These are the features most frequently used to separate taxa of *Vaccinium* sect. *Cyanococcus* in the field.

For the gene exchange trial, small populations (three to 59 plants) were grown from seed of a single colony. In all, 24 such populations from ten sites were begun for the polymorphic *Vaccinium angustifolium*, and were kept for two years in a cold frame. The provenance of the 24 populations was as follows: Kaladar, Ontario — three populations "*lamarckii*," "*brittonii*," and "*angustifolium*" 59 plants; Rock Dunder, Morton, Ontario — two populations "*lamarckii*" and "*brittonii*" 18 plants; Blue Mountain, Lansdowne, Ontario — two populations "*angustifolium*" and "*brittonii*" 14 plants; Mt. Fitzsimmons, Ivy Lea, Ontario — three populations "*angustifolium*," "*brittonii*," and "*lamarckii*" 17 plants; Port Maitland, Nova Scotia — two populations "*lamarckii*" and "*angustifolium*" 12 plants; Port Franks, Ontario — one population "*lamarckii*" three plants; Wolfville, Nova Scotia — three populations "*lamarckii*," "*brittonii*," and "*angustifolium*" 27 plants; West Branch, Pictou County, Nova Scotia — three populations "*la-*

*marckii*," "*brittonii*," and "*angustifolium*" 27 plants; Flat River, Prince Edward Island — one population "*angustifolium*" 24 plants; and Bonavista, Newfoundland — one population "*lamarckii*" 24 plants.

All these plants were moved from the cold frame into the greenhouse on 17 April 1974, where they began to flower after 20 days. And for the next 30 days, every morning open corollas were removed from several plants, the pollen removed and applied only once to mature stigmata on different plants from the same locality (population cross) or from another locality (local cross) or from a locality more than 100 km distant (regional cross).

#### RESULTS

Following the foraging behaviour of individual bumblebee queens of *Bombus ternarius*, *B. terricola* and *B. bimaculatus* during May of 1971 and 1972 in eastern Ontario, I noted a polylectic feeding strategy. Table 1 shows a typical set of results which can best be explained by chance foraging behaviour on the part of individual bees.

This foraging behaviour has been verified by Vander Kloet (1976a) when he investigated the composition corbicular pollen loads of both solitary and colonial bees on *Vaccinium angustifolium*, *V. corymbosum*, *V. myrsinites* and *V. darrowii*. Microscopic examination of stigmata also showed that they are encrusted by a variety of pollen grains including those from neighbouring *Vaccinium* taxa.

Furthermore, pollination biology studies of the *Vaccinium angustifolium* complex have shown that the flower is functionally and physiologically self sterile (Camp, 1942; Aalders & Hall, 1961; Wood, 1968; Vander Kloet, 1972, & 1976a). Therefore, which of these "alien" pollen grains contribute to seed set can be determined by growing the seedlings from open pollinated berries.

Table 2 gives the results from one such germination trial. Open pollinated berries, collected from "*angustifolium*," "*brittonii*," and "*lamarckii*" give a progeny of the other two morphs that indicates that these three morphs do not breed true under field conditions. The observed difference in frequency of progeny has been correlated with the frequency of the parental populations (Vander Kloet, 1976b).

The frequency of occurrence of the species and morphs at the nine different sites is given in Table 3. Not only does the frequency of "*brittonii*" vary sharply from site to site, but, also, it always occurs with "*angustifolium*" and "*lamarckii*." Additional observations made in 1974 and 1975 also support this conclusion: "*brittonii*" does not occur in the absence of "*angustifolium*" or "*lamarckii*"; the last two, however, always occur together. The other *Vaccinium* species which occasionally occur with the *V. angustifolium* complex have a distinct geographical range as well as habitat differences (Vander Kloet, 1977).

Moreover, that these three morphs intermingle on a given site has been observed, among others, by Scoggan (1957) in Manitoba, by Lakela (1965) in northeastern Minnesota, by Roland and Smith (1969) in Nova Scotia, by Duis (1941) in West Virginia, and Deam (1940) in Indiana. Collection data gleaned from herbarium specimens examined at DAO, CAN, TRT, ACAD, QK, GH, NYS, US, NY, MTMG, SFS, and QFA indicate not only that the three morphs share the same habitat, but also that the geographical ranges of "*brittonii*" and "*lamarckii*" are entirely contained within the range of "*angustifolium*" mapped collectively in Figure 1.

Field observations revealed no pattern or sequence of flowering that would permit me to partition the three morphs in the field. Indeed, location, exposure, and age of colony seemed to govern timing of anthesis. In Leeds County, Ontario, shrubs on steep, exposed, south-facing slopes of Precambrian outcrops began to flower in 1970 on May 5th regardless of morph disposition. Moreover, adjacent to these precocious colonies were several serotinous shrubs which did not begin to flower until May 19th. The same absence of a flowering pattern was observed in Pictou County, Nova Scotia, during 1973 and 1974 in spite of the fact that flowering does not begin until the first week in June.

According to McMillan and Pagel (1958), at least two variables affect the phenology of plants: (1) the site variable involving both differences from point to point, i.e. the microhabitat, and from year to year, the annual fluctuation, and (2) the genetic variable, i.e. differences in response to the same habitat due to different genetic potentials of the individuals involved.

To minimize these variables, I decided to follow the phenology of the even aged population prepared for the gene exchange trial and kept in the greenhouse since 17 April 1974 at 18°C at night and

22° C during the day and a light regime of 16 hours. The first shrub began to flower after 20 days, the last after 31 days. But no significant difference in flowering sequence was discovered among these three morphs.

That these greenhouse grown plants from the three morphs interbreed freely with one another is demonstrated in Table 4. The relatively low set success (41%), which does not significantly vary among the morphs, I attribute to low pollen production. Boulanger *et al.* (1967) also reported low pollen production in *Vaccinium angustifolium* sensu lato. But under field conditions, each corolla is visited a minimum of three times by pollinators whose bodies are covered with pollen, and these visitations result in high set success. However, Wood (1971) discovered that the addition of hives of honey-bees to blueberry fields did not increase the number of seeds per berry.

Finally, the morphological data accumulated in this study again failed to give me a criterion to separate these three morphs efficiently.

Although each of these lines of evidence is insufficient in itself, when they are combined and added to the cytological and genetic data cited in the introduction, the degradation of these three "species" to a lower rank is fully warranted. In effect, all of these moderately strong individual probabilities are combined to produce an overall certainty — namely that these morphs comprise one polymorphic species, *Vaccinium angustifolium* Aiton.

#### TAXONOMY

***Vaccinium angustifolium* Aiton, Hort. Kew, ed. 1. 2: 11. 1789.**

*V. pensylvanicum* Lamarck, Encycl. 1: 74. 1783, non *V. pensylvanicum* Miller, Gard. Dict. ed. 8. 1768 = *Royena glabra*, nec *V. pensylvanicum* var. *angustifolium* (Aiton) Gray, Man. ed. 1: 261. 1848, misapplied to *V. boreale* Hall & Aalders.

*V. pensylvanicum* var. *nigrum* Wood, Classbook ed. 1861. p. 252.

*V. nigrum* (Wood) Britton, Mem. Torr. Bot. Club 5: 252. 1894.

*V. pensylvanicum* f. *leucocarpum* Deane, Rhodora 3: 264. 1901.

*V. brittonii* Porter ex Bicknell, Bull. Torr. Bot. Club 41: 420. 1914.

*V. angustifolium* var. *laevifolium* House, Bull. N.Y. State Mus. 243, 244: 61. 1923.

*V. angustifolium* var. *nigrum* (Wood) Dole, Fl. Vermont ed. 3. 210. 1937.

*V. lamarckii* Camp, Bull. Torr. Bot. Club 71: 180. 1943.

*V. angustifolium* var. *hypolasium* Fernald, Rhodora 51: 104. 1949.

*V. angustifolium* f. *nigrum* (Wood) Boivin, Nat. Can. 93: 437. 1966.

*Cyanococcus angustifolius* (Aiton) Rydberg, Brittonia 1: 94. 1931.

Shrub (10–)20(–60) cm high, in dense, extensive colonies. Twigs of the current season green or glaucous, angular, verrucose, glabrous to pubescent. Leaves elliptic to narrowly elliptic; (5–)11(–20) mm wide, (15–)26(–41) mm long; green or blue green; glabrous, glaucous or pubescent beneath; margin sharply serrate, rarely entire. Calyx and pedicel glaucous or glabrous, rarely pubescent. Corolla cylindrical to urceolate; (4–)5(–6) mm long; white, occasionally with pink striping. Filaments ciliate along the margins, occasionally pubescent. Style glabrous. Pollen tetrads (36–)39(–41)  $\mu\text{m}$  in diameter. Berry blue and glaucous, dull black, or shining black, rarely white, (3–)6(–10) mm in diameter; each containing 36–(56)–86 seeds. Chromosome number:  $2n = 48$ .

Whether or not segments of this polymorphic species should be recognized at an infraspecific level remains a moot point. Apparently, character sets are not constant from generation to generation and novel recombinations occur from time to time. Moreover, Mosquin (1971) argues that, while such descriptions are useful in drawing attention to such segments, the names more often than not turn out to be useless and, even worse, a misleading burden to biological literature.

**Range:** Labrador and Newfoundland, west to southern Manitoba and Minnesota, south to northern Illinois, Pennsylvania, and Delaware and in the mountains to Virginia and West Virginia (Figure 1).

**Type locality:** "Native of Newfoundland and Labrador". Pouch Cove, Newfoundland, *vide* W. G. Dore (pers. com.). Introduced at Kew about 1776 by Benjamin Bewick. Type at BM, seen in 1975.

Since both *Vaccinium angustifolium* and *V. boreale* occur in Newfoundland and Labrador, some confusion has prevailed as to whether the type, taken from material cultivated at Kew, applies to *V. angustifolium* or *V. boreale*. Using stomata peels, Aalders and Hall (1962) showed that the type fitted better in the tetraploid *V. angustifolium*. Regarding leaf size and shape, the Morse (1971) polyclave system for plant identification also suggests that the type fits better into *V. angustifolium* than *V. boreale*.

**Habitat:** headlands, high moors, dry sandy areas, peaty barrens, exposed rocky outcroppings of the Canadian Shield, jack-pine barrens, pitch-pine barrens, oak parklands, poplar regeneration forests

Table 1.

Foraging behaviour of *Bombus ternarius*, *B. terricola*, and *B. bimaculatus* on a granite outcropping 3 km west of Chaffey's Locks, Ontario.<sup>1</sup>

FROM \ TO	"angustifolium"	"brittonii"	<i>Arctostaphylos uva-ursi</i>
"angustifolium"	36	67	49
"brittonii"	31	60	49
<i>A. uva-ursi</i>	58	87	80
	$X^2 = 1.54$	$P (.05 = 9.488)$	

<sup>1</sup>Observation times: May 14, 1971 to May 18, 1971 and May 20, 1972 to May 28, 1972.

Table 2.

Distribution of progeny from 12 berries collected at random in 1970, 1971, & 1974 from colonies of "angustifolium," "brittonii" & "lamarckii" at Kaladar, Ontario.

PARENTS \ PROGENY	"brittonii"	"angustifolium"	"lamarckii"
KE 127* "brittonii" (4 berries)	22	20	6
KE 130 "angustifolium" (4 berries)	12	35	9
KE 134 "lamarckii" (4 berries)	1	17	4

\*Voucher specimens in ACAD.



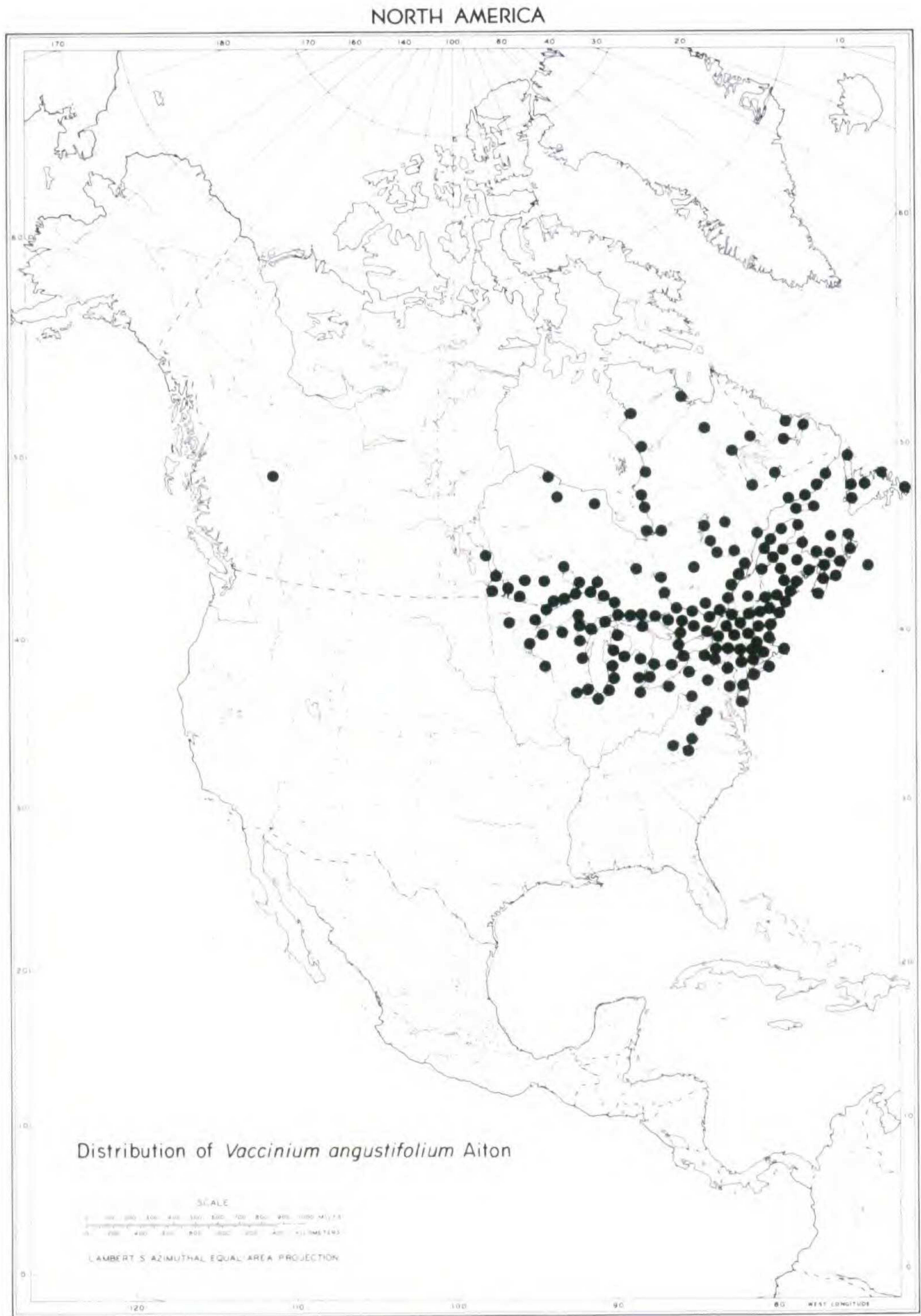


Figure 1. Distribution of *Vaccinium angustifolium* Aiton.

and in the Maritimes and New England especially abandoned pastures and bogs.

The natural habitats of *Vaccinium angustifolium* sensu lato were briefly described by Camp (1945) and Vander Kloet (1977). It is tolerant of a wide range of temperature, including frequent burning, but is intolerant of dense shade and grows most luxuriantly on fired barrens. Occurrence is restricted to acid soils. The average pH for 60 soils in which it was growing was 4.4 with a range between 2.8 and 6.6 (Vander Kloet, 1972, & unpublished).

**Floral Biology:** flower buds are formed in late summer and open the following April (in New Jersey), May (in Ontario) or June (in Nova Scotia). Occasional plants may bloom in September and October and a few precocious buds may open in March in very favoured situations. Reproduction is amphimictic, the flowers perfect, entomophilous; the most frequent pollinators are *Andrena vicina*, *A. carlini*, *Bombus bimaculatus*, *B. terricola*, *B. ternarius* and *B. perplexus* (Boulanger *et al.*, 1967; Vander Kloet, 1972 & 1976a).

Dispersal of the fruit and seed is primarily effected by birds and mammals. In the Maritimes and New England, robins and bears are particularly effective dispersal agents. Seedling establishment varies sharply throughout the species' range — from frequent in the Maritimes to none during the last forty years in eastern Ontario (Vander Kloet, 1976c).

Finally, I have postulated a recent hybrid origin followed by autopoloidy for *Vaccinium angustifolium* sensu stricto (Vander Kloet, 1977). Subsequent introgression with *V. corymbosum* has resulted in the addition of glaucescence and pubescence to this taxon to give *V. angustifolium* its present polymorphic status.

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Table 3.

Frequency of occurrence of "angustifolium," "brittonii," "lamarckii" on several sites in eastern North America.

Sites	"brittonii"	"lamarckii"	"angustifolium"	V. myrtilloides	V. boreale	V. pallidum
Kaladar, Ont.	24	7	42	0	0	0
Delta, Ont.	42	43	12	0	0	0
Degelis, P.Q.	0	4	5	8	0	0
Gagetown, N.B.	0	1	8	4	0	0
Liberty, Me.	9	3	12	3	0	0
Lee, N.H.	0	18	34	0	0	1
West Branch, N.S.	23	16	40	6	0	0
Flat River, P.E.I.	1	6	21	0	0	0
Bonavista, Nfld.	0	18	34	0	2	0

Table 4.

Single link reciprocal crosses among "angustifolium," "lamarckii" and "brittonii"

Taxa	Population cross (plants from a single hm.)			Local cross (plants from a 50 km radius)			Regional cross (plants more than 100 km apart)		
	crosses	berries	seedlings	crosses	berries	seedlings	crosses	berries	seedlings
angustifolium × angustifolium	19	10	33	26	15	81	94	37	84
angustifolium × lamarckii	32	12	6	58	27	61	100	31	193
angustifolium × brittonii	36	21	36	62	24	44	141	53	176
lamarckii × brittonii	13	5	—	41	22	68	33	15	28
lamarckii × lamarckii	12	2	8	13	6	7	19	9	52
brittonii × brittonii	10	6	20	21	7	36	14	3	—

## LITERATURE CITED

- AALDERS, L. E., & I. V. HALL. 1961. Pollen incompatibility and fruit set in lowbush blueberries. *Can. Jour. Genet. Cytol.* **3**: 303-307.
- . & ———. 1962. New evidence on the cytotaxonomy of *Vaccinium* species as revealed by stomatal measurements from herbarium specimens. *Nature* **196**: 694.
- , & ———. 1963. The inheritance and taxonomic significance of the "nigrum" factor in the common lowbush blueberry, *Vaccinium angustifolium*. *Can. Jour. Genet. Cytol.* **5**: 115-118.
- BENT, F. C., & S. P. VANDER KLOET. 1976. Reports on Ericaceae. *In*: IOPB chromosome number reports LII, presented by A. Löve. *Taxon* **25**: 344-345.
- BOULANGER, L. W., G. W. WOOD, E. A. OSGOOD & C. O. DIRKS. 1967. Native bees associated with the lowbush blueberry in Maine and eastern Canada. *Maine Agr. Expt. Sta. Tech. Bull.* 26.
- CAMP, W. H. 1942. On the structure of populations in the genus *Vaccinium*. *Brittonia* **4**: 189-204.
- . 1945. The North American blueberries with notes on other groups of Vacciniaceae. *Brittonia* **5**: 203-275.
- DARROW, G. M., W. H. CAMP, H. E. FISCHER, & H. DERMEN. 1944. Chromosome numbers in *Vaccinium* and related groups. *Bull. Torrey Bot. Club* **71**: 498-506.
- DEAM, C. C. 1940. *Flora of Indiana*. Division of Forestry, Department of Conservation, Indianapolis, Indiana.
- DORE, W. G. 1970. Personal communication.
- DUIS, W. H. 1941. Selection of the low-bush blueberry in West Virginia. *Am. Soc. Hort. Sci.* **38**: 434-437.
- FERNALD, M. L. 1950. *Gray's manual of botany*. 8th ed. American Book Co., New York.
- GLEASON, H. A. 1952. *The new Britton and Brown illustrated flora of the northeastern United States and adjacent Canada*. New York Botanical Garden, New York.
- GRAY, A. 1848. *A manual of the botany of the northern United States from New England to Wisconsin and south to Ohio and Pennsylvania inclusive*. J. Munroe & Co., Boston; J. Chapman, London.
- HALL, I. V., & L. E. AALDERS. 1961. Cytotaxonomy of lowbush blueberries in eastern Canada. *Am. Jour. Bot.* **48**: 199-201.
- HERSEY, R., & S. P. VANDER KLOET. 1976. Reports on Ericaceae. *In*: IOPB chromosome number reports LII, presented by A. Löve. *Taxon* **25**: 342-343.
- HOLMGREN, P. K., & W. KEUKEN. 1974. *Index herbariorum*. Pt. 1. The herbaria of the world. 6th ed. Oosthoek, Scheltema and Holkema, Utrecht, Netherlands.
- LAKELA, O. 1965. *Flora of northeast Minnesota*. Univ. Minnesota Press, Minneapolis.
- MCMILLAN, C., & B. F. PAGEL. 1958. Phenological variation within a population of *Symphoricarpos occidentalis*. *Ecology* **39**: 766-770.
- MORSE, L. E. 1971. Specimen identification and key construction with time-sharing computers. *Taxon* **20**: 269-282.

- MOSQUIN, T. 1971. Evolutionary aspects of endemism. *Nat. Can.* **98**: 121-130.
- ROLAND, A. E., & E. C. SMITH. 1969. The flora of Nova Scotia. Pt. 2. The Dicotyledons. *Proc. N. S. Inst. Sci.* **26**: 277-743.
- SCOGGAN, H. J. 1957. Flora of Manitoba. Canada Dept. of Northern Affairs and National Resources, Ottawa.
- SMITH, D. W. 1969. A taximetric study of *Vaccinium* in northeastern Ontario. *Can. Jour. Bot.* **47**: 1747-1759.
- VANDER KLOET, S. P. 1972. The North American blueberries revisited: a taxonomic study of *Vaccinium* section *Cyanococcus* Gray. Ph.D. Thesis, Queen's University at Kingston, Ontario.
- . 1976a. Nomenclature, taxonomy, and biosystematics of *Vaccinium* section *Cyanococcus* (the blueberries) in North America. I. Natural barriers to gene exchange between *Vaccinium angustifolium* Ait. and *Vaccinium corymbosum* L. *Rhodora* **78**: 503-515.
- . 1976b. A novel approach to sampling *Vaccinium* populations. *Can. Jour. Bot.* **54**: 669-671.
- . 1976c. A comparison of the dispersal and seedling establishment of *Vaccinium angustifolium* (the lowbush blueberry) in Leeds County, Ontario and Pictou County, Nova Scotia. *Can. Field Nat.* **90**: 176-180.
- . 1977. The taxonomic status of *Vaccinium boreale* Hall and Aalders. *Can. Jour. Bot.* **55**: 281-288.
- WHITTON, L. 1964. The cytotaxonomic status of *Vaccinium angustifolium* Aiton in commercial blueberry fields of Maine. Ph.D. Dissertation, Cornell University, Ithaca, N.Y.
- WOOD, A. 1861. Class-book of botany . . . with a flora of the United States and Canada. A. S. Barnes, New York.
- WOOD, G. W. 1968. Self-fertility in the lowbush blueberry. *Can. Jour. Plant Sci.* **48**: 431-433.
- . 1971. The relationship between pollinator density and seed number in lowbush blueberry. *HortScience* **6**: 413.

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#### APPENDIX I. LOCATION OF SAMPLING SITES\*

1. West St. Modeste, Labrador, 51°36'N/56°45'W.
2. St. Anthony Hill, St. Anthony, Newfoundland.
3. Blomidon Mountain, Humber West, Newfoundland.
4. Mt. Sykes, Birch Bay, Humber East, Newfoundland.
5. Massive headlands, 2 km SW of Bonavista, Newfoundland.\*
6. Ballyhack Point, Avondale, Harbour Maine, Newfoundland.
7. Pouch Cove, St. John's North, Newfoundland.
8. French Mountain, Cape Breton Highlands, Inverness County, Nova Scotia.

9. Kennington Cove, Cape Breton County, Nova Scotia.
10. Margaree Municipal Airport, Frizzleton, Inverness County, Nova Scotia.
11. Biorachan Road, Earltown, Colchester County, Nova Scotia.
12. A 2 ha poverty grass meadow 3.2 km west of West Branch, Pictou County, Nova Scotia.\*
13. Red Head, Port Maitland, Yarmouth County, Nova Scotia.
14. Lake George, Yarmouth County, Nova Scotia.
15. An open white spruce regeneration forest along the Trans Canada Highway 1 km south of Flat River, Queen's County, Prince Edward Island.\*
16. North River, Queen's County, Prince Edward Island.
17. Point Deroche, Queen's County, Prince Edward Island.
18. A popular regeneration forest in CFB Gagetown along hwy 7, 7.8 km south of Geary, Sunbury County, New Brunswick.\*
19. A disturbed margin of a raised bog, along hwy 2, 500 m NW of the New Brunswick border, Temiscouata County, Quebec.\*
20. Beaven Lake, near Arundel, Argenteuil County, Quebec.
21. A 1.7 ha granite-gneiss outcrop, 0.5 km north of Kaladar, Lennox and Addington County, Ontario.\*
22. Rock Dunder, 3 km SW of Morton, Leeds County, Ontario.
23. Lake Opinicon, Chaffey's Locks, Leeds County, Ontario.
24. Blue Mountain, Charleston Lake, near Lansdowne, Leeds County, Ontario.
25. Red Horse Lake, near Lansdowne, Leeds County, Ontario.
26. Mt. Fitzsimmons, near Ivy Lea, Leeds County, Ontario.
27. A 2.4 ha quartzite outcrop 4 km south of Delta, Leeds County, Ontario.\*
28. Hebert Bog, Upper Rock Lake, Frontenac County, Ontario.
29. Washburn, Frontenac County, Ontario.
30. Turkey Point, Norfolk County, Ontario.
31. Pinery, Port Franks, Lambton County, Ontario.
32. Wells Island, Jefferson County, New York.
33. Butterfield Lake, Jefferson County, New York.
34. Sag Harbor, Long Island, Suffolk County, New York.
35. An old field, 8 km west of Liberty along hwy 3, Waldo County, Maine.\*
36. Mt. Washington, White Mountains, Coos County, New Hampshire.
37. An oak-hickory forest surrounding Wheelwright Pond at Lee, Strafford County, New Hampshire.\*
38. Mast Way, Lee, Strafford County, New Hampshire.
39. Reservoir System, Framingham, Middlesex County, Massachusetts.
40. Jeremy Run, Skyline Drive, Shenandoah National Park, Rappahannock County, Virginia.

\*Frequency sampling site.

#### APPENDIX II. CITATION OF SELECTED SPECIMENS

**Newfoundland.** HUMBER DISTRICT: Hannah's Head (Mt. Patricia), *Rouleau 335* (DAO); Cornerbrook, *Rouleau 42* (DAO). FOGO DISTRICT: Gander River, First Pond, *Rouleau 5406* (DAO); Joe Batt's Arm, *Brett* in 1945 (ACAD); Fredericton, *Ludlow 156* (ACAD). GANDER DISTRICT: south side of Gander, *Bassett 1036* (DAO). FERRY-

LAND DISTRICT: Witless Bay line, *Rouleau 5401* (DAO). CARBONEAR — BAY DE VERDE DISTRICT: Old Pelican, Cooks Pond, *Rouleau 5708* (DAO). GREEN BAY DISTRICT: Springdale Turn-off, *Rouleau 7318* (ACAD). LABRADOR: Brule, Happy Valley, *Gardner & Desroches 846* (QFA); Bassin de la R. Saint John, 51°07'N/63°47'W, *Dutilly & Lepage 41392* (QFA); Area 25, *Judd GB47* (DAO). Hodgewater, *Cameron 12222* (ACAD). Holyrood, Butter Pot Ponds, *Erskine 3014* (ACAD). Port de Grave, *Lear 11988* (ACAD). **Nova Scotia.** VICTORIA COUNTY: Ingonish, *Roland 41647* (DAO); Slaty Point, Clyburne Brook, *Smith et al. 4368* (DAO); Black Brook Cove, *Smith et al. 4356* (ACAD); Lockhart Brook, Salmon River, *Smith et al. 6366* (ACAD). LUNENBURG COUNTY: Deep Cove, Aspotogan Mt., *Hart 1152* (DAO); Indian Lake, *Smith et al. 8980* (ACAD). KINGS COUNTY: Auburn Barrens, *McLellan DA024* (DAO); Cambridge Station, *Webster 7* (ACAD). HALIFAX COUNTY: Sable Island, *Erskine 53-1091* (DAO); Melville Cove near Halifax, *Gorham 451368* (DAO); Peggy's Cove, *Smith et al. 17518* (ACAD). DIGBY COUNTY: Brier Island, *Roland et al. 299* (ACAD). PICTOU COUNTY: Pictou Landing, *Smith et al. 16683* (ACAD); 5 miles NW of Pictou, *Smith et al. 11572* (ACAD). HANTS COUNTY: Sackville River S of Mt. Uniacke, *Smith et al. 17610* (ACAD); Lantz, *Smith et al. 6028* (ACAD); Kennetcook Corners, *Smith et al. 9212* (ACAD). CUMBERLAND COUNTY: Crossroads, *Schofield & Bentley 4709* (ACAD); Jeffers Brook, *Smith et al. 19079* (ACAD). ANTIGONISH COUNTY: Linwood, *Smith et al. 10763* (ACAD); Pomquet Point, *Smith et al. 13681* (ACAD). SHELBURNE COUNTY: Clarke's Harbour, Cape Sable Island, *Smith et al. 7191* (ACAD). GUYSBOROUGH COUNTY: Lincolnville, *Smith et al. 7441* (ACAD). QUEEN'S COUNTY: Caledonia, *Smith et al. 11532* (ACAD). ANNAPOLIS COUNTY: 4 miles W of West Dalhousie, *Smith et al. 14540* (ACAD). INVERNESS COUNTY: head of MacGregor Brook, *Smith et al. 3807* (ACAD). CAPE BRETON COUNTY: Eastern Harbour, Scatari Island, *Smith et al. 8398* (ACAD). **Prince Edward Island.** PRINCE COUNTY: Alberton, *Fernald & St. John 7919* (NASP). KINGS COUNTY: Bristol, Lot 40 Station, *Erskine & Smith 2299* (DAO); Basin Head, *Griffin & Griffin* in 1972 (ACAD); 5 miles SE of Mt. Stewart, *Erskine 1603* (ACAD); Peake's Station, *Erskine 1603* (DAO); Bothwell, 10 miles E of Souris, *Erskine & Smith 2010* (ACAD). QUEEN'S COUNTY: Brackley Point, *Erskine 1780* (DAO); Charlottetown, *Erskine & Smith 1755* (DAO). **New Brunswick.** QUEEN'S COUNTY: W of New Canaan, *Roberts & Bateman 641742* (DAO); Starkey Bridge, *Smith et al. 15950* (ACAD). ALBERT COUNTY: Top of Gowland Mountain, *Roberts & Bateman 641542* (DAO); Nixon, *Smith et al. 18646* (ACAD); Weldon, *Smith et al. 18636* (ACAD). CHARLOTTE COUNTY: Tower Hill, near Moore's Mills, *Dore & Hall 13718* (DAO); Grand Harbour, Grand Manan, *Perry 13653* (ACAD); St. Stephen, *Haley 12755* (ACAD). WESTMORELAND COUNTY: Upper Rockport-Wood Point, *Roberts & Bateman 642463* (DAO); Moncton, *Perry* in 1920 (ACAD). KENT COUNTY: Cocagne, *Smith et al. 16635* (DAO); Nr. Cocagne River on road to Shediac Bridge, *Roberts & Bateman 64-2853* (ACAD). NORTHUMBERLAND COUNTY: Mount Carleton, *Smith & Clattenburg 20076* (ACAD); Doaktown, *Smith et al. 18714* (ACAD); Portage Brook near Popple Depot, *Roberts & Bateman 64-4254* (ACAD); Newcastle, *Scoggan 12101* (ACAD). GLOUCESTER COUNTY: Bass River, *Smith et al. 16575* (ACAD). KINGS COUNTY: Berwick, *Smith et al. 18878* (ACAD). ST. JOHN COUNTY: Lily Lake, St. John, *Hay 271* (ACAD). **Quebec.** KAMOURASKA COUNTY: Ste. Anne, *Hamel & Payette 730* (DAO). RIMOUSKI COUNTY: Bic, *Breitung 490* (DAO). SAGUENAY COUNTY: Port-Cartier, *Sherk & Cinq-Mars 516* (DAO); Ile Ouapitagone, Archipel Ouapita-



gone, *St. John* 90663 (GH); Harrington Harbour, 50°30'N/59°29'W, *Swales* 745 (MTMG). CHARLEVOIX COUNTY: Baie St-Paul, *Raymond & Champagne* 56-879 (DAO); Baie St-Paul, *Marie-Victorin et al.* 56879 (ACAD). TEMISCOUATA COUNTY: Rivière-du-Loup, *Cody et al.* 695 (DAO); Rivière-du-Loup, *Soper & Fraser* 3663 (TRT). PORTNEUF COUNTY: Saint-Gilbert, *Marie-Victorin et al.* 2487 (ACAD). ROBERVAL COUNTY: Péribonka, *Lavoie* 9 (ACAD). LÉVIS COUNTY: St-Romuald, *Gravel & Tessier* 69-23 (ACAD). JACQUES-CARTIER COUNTY: Ile-Perrôt, *Cinq-Mars* 64-441 (ACAD). CHAMBLY COUNTY: Chemin du Lac, Longueuil, *Rolland-Germain* 485 (ACAD). WOLFE COUNTY: Garthby Twp., Chalet Hill, *Blais & Hamel* 11250 (ACAD). ARTHABASKA COUNTY: Sainte-Clothilde, *Marie-Victorin et al.* 2068 (ACAD). CHICOUTIMI COUNTY: Saint-Fulgence, *Cayouette* 7005 (ACAD). ABITIBI-EAST COUNTY: Maizeret Twp., Harricanaw River, 49°12'N/78°03'W, *Bentley* 58142 (MTMG). East Coast of Hudson Bay, Old Factory, 52°33'N/78°15'W: *Dutilly & Lepage* 12291 (GH). East Coast of Hudson Bay, Head of Richmond Gulf, *Spreadborough* 14404 (CAN). Richmond Gulf, East Coast of Hudson Bay, Wiachewan River, *Abbe & Abbe* 3380 (GH). Lac Mistassini, Baie Rousseau, 51°04'N/73°20'W: *Rousseau & Rouleau* 747 (GH). Côte-Nord, Pointe-aux-Esquimaux, *Marie-Victorin & Rolland-Germain* 18358 (GH). New Quebec, entre Fort George et la Baie aux Oies, 53°54'N/79°07'W: *Lepage* 12635 (DAO). New Quebec, Lac Ayde, 52°20'N/73°25'W: *Haber & Bergeron* 2262 (CAN). James Bay, Harricanaw River, 48°20'N: *Dutilly & Lepage* 15168 (QFA). James Bay, Lac Desaulniers, 53°35'N/77°35'W: *MacCulloch* in 1973 (MTMG). Ungava Oriental, River George, 55°55'N: *Rousseau* 413 (DAO); Central Ungava, Knob Lake Area, Lake Gillard, 30-35 miles NW of Burnt Creek, *Mustich* 621 (CAN). Rupert House, 51°29'N/78°46'W: *Spafford* 17 (DAO). Lac Pomerleau, Mt. Otish, 52°20'N/70°35'W: *Rousseau & Pomerleau* 166 (DAO). Péribonka Region, around Lake Alex and Patrick West River: *Hustich* 621 (CAN). Opinac Lake Quad, 52°03'N/77°08'W: *Argus* 9529 (CAN). Longue Pointe de Mingan, 50°18'N/64°01'W: *Gillett* 4986 (ACAD). **Ontario.** ELGIN COUNTY: near St. Thomas, Malahide Twp., *James* DAO114 (DAO). CARLETON COUNTY: "The Sand Hills" Torbolton Twp. (LI9C5), *Breitung* in 1946 (DAO); Constance Bay, *Senn* 708 (NY). RENFREW COUNTY: Petawawa, *Breitung* 6905 (DAO). THUNDER BAY DISTRICT: Paradise Island (off SW corner of St. Ignace Island), *Garton* 6616 (DAO). GRENVILLE COUNTY: 3 mi. SW of Prescott, *Dore* 18036 (DAO). GLENGARRY COUNTY: Raisin River, W of the 401 Lancaster Bridge, *Gogo* 507 (DAO). ALGOMA DISTRICT: vicinity of Michipicoten Harbour 48°00'N/85°00'W, *Hosie et al.* 1283 & 1312 (ACAD); 48°00'N/84°49'W, 47°56'N/84°52'W, 48°06'N/84°30'W, Wawa, *Garton et al.* 14669, 14041, 14430 (ACAD); John Island, *Grassl* 2438 (NY). HASTINGS COUNTY: Marmorata Twp. 5 miles ENE of Marmorata, *Gillett & Calder* 6280 (NY). MUSKOKA DISTRICT: Gravenhurst, *Biltmore Herbarium* 5617 (NY). LEEDS COUNTY: La Rue Island, 1000 Islands, *Bicknell* in 1905 (NY). **Manitoba.** Maskwa Rapids, *Löve & Löve* 5515 (DAO). Sandilands Forest Reserve, 60 miles SE of Winnipeg, *Breitung* 7907 (DAO). Victoria Beach, East shore of Lake Winnipeg, *Breitung* 7832 (DAO). Whiteshell Provincial Park, 100 miles E of Winnipeg, *Wishart* 19 (MTMG).

**Michigan.** CHARLEVOIX COUNTY: Beaver Island, *Voss* 3886 (MICH). OSCEOLA COUNTY: 6.5 miles SE of Marion, *Voss* 9464 (MICH). KALKASKA COUNTY: 5 miles E of Kalkaska, *Voss* 3807 (MICH); Coldsprings Twp., *LaRue* 35 (MICH). WEXFORD

COUNTY: 5 miles WSW of Hoxeyville, *Voss 4489* (MICH). NEWAGO COUNTY: 1.5 miles S of Bridgetown, *Hermann 8632* (MICH). **Minnesota.** ST. LOUIS COUNTY: 4 miles S of Gilbert, *Lakela 3472* (NY); Grand Lake, 18 miles N of Duluth, *Lakela 2875* (NY). WINONA COUNTY: Trempealeau Ridge, *Holzinger* in 1901 (NY). HUBBARD COUNTY: Park Rapids, *Palmer 36829* (NY). CHISAGO COUNTY: Taylors Falls, *Rydberg 9619* (NY). CLEARWATER COUNTY: Itasca Park, headwaters of the Mississippi River, *Moyle 37* (NY). *Benedict, Bergman 3146* (NY). **Ohio.** TRUMBULL COUNTY: *Shanks 2264* (NY). LUCAS COUNTY: *Bartley & Pontius 761* (NY). **Illinois.** KANKAKEE COUNTY: near St. Anne, *Jones 11400* (NY). **Wisconsin.** WASHBURN COUNTY: Township 40 N, Range 13 W Casey, *Galletta 8101* (NCSC). BURNETT COUNTY: Section 12, Twp. 41N, Range 14W (13 mi E of Minnesota line), *Galletta 812* (NCSC). VILAS COUNTY: Plum Creek Avenue, St. Germain, 2.2 mi from Hwy 70, *Galletta 8163 & 8162* (NCSC). SAUK COUNTY: West Bluff, Devils Lake, *Fassett 3313* (NY). MARINETTE COUNTY: Marinette, *Phuette* in 1891 (NY). Wisconsin Point, Lake Superior, *Gillman* in 1876 (NY). West De Pere, Wolf River Dells, *Keefe* in 1938 (NY). **Maine.** PENOBSCOT COUNTY: Stillwater River, 3 miles NW of Old Town, *Rosbach 4840 & 4841* (ACAD); Upper Stillwater, *Fernald 362* (NY). KNOX COUNTY: Dodge Mt. near Rockland Line, Rockport, *Rosbach 1821* (ACAD); between Athearn's and North Hope Corners, *Rosbach 4017* (ACAD); Union, *Cole 905* (NY); Jones Mt., Hope, *Cole 937* (NY). FRANKLIN COUNTY: near summit of Sugarloaf Mt., *Rosbach 5266* (ACAD); summit ridge of Saddleback Mt., *Rosbach 5991* (ACAD). WALDO COUNTY: Grindel Point, Islesboro, *Rosbach, 3587* (ACAD); Little River, SW of Belfast, *Rosbach 4780* (ACAD); Spear's Mountain, at 1000 ft. elevation, Montville, *Rosbach 4700* (ACAD); Swanville, *Chamberlain 1905* (NY). PISCATAQUIS COUNTY: Mount Katahdin, *Walker 1883* (NY). LINCOLN COUNTY: Dodge's Point, Damariscotta River, *Wilson 221* (NY). WASHINGTON COUNTY: between Jonesboro and Meddybemps, *Eggleston et al. 22236* (NY); Cherryfield, *Coville US1489770* (US). AROOSTOOK COUNTY: township XI, Range 16, *St. John & Nichols 2439* (NY). **York County.** OCEAN PARK, *Moldenke 1581* (NY); York, *Bicknell 6911* (NY). **New Hampshire.** GRAFTON COUNTY: Black Mountain near East Haverhill, *Muenschler & Clausen* in 1934 (NY). COOS COUNTY: Lancaster, *Blanchard* in 1911 (NY). CHESHIRE COUNTY: Hinsdale, *Batchelder* in 1919 (NY); Marlboro, *Rusby* in 1919 (NY). Greenfield, *Coville US494774* (US). **Vermont.** RUTLAND COUNTY: Proctor, *Banker 201* (NY); Twin Mountains, West Rutland, *Eggleston 1451* (NY). WINDHAM COUNTY: Westminster, *Blanchard 140* (NY); Jamaica, *Moldenke 9560* (NY). CHITTENDEN COUNTY: Camels Hump, *Blanchard* in 1918 (NY); The Chin, Mt. Mansfield, *Edmondson 5216* (NY); Mt. Mansfield, *Blanchard* in 1912 (NY). **Massachusetts.** NANTUCKET COUNTY: Nantucket Island, *Mackeever 562* (NY). MIDDLESEX COUNTY: Melrose, *Morong* in 1877 (NY); Winchester, *Smith 1171* (NY). DUKES COUNTY: Martha's Vineyard, West Tisbury, *Mackeever 134* (NY). BARNSTABLE COUNTY: Dennis, *Fernald & Long 17276* (NY). WORCESTER COUNTY: Worcester, *Edmondson 334* (NY). BERKSHIRE COUNTY: Tyringham, *Vail* in 1897 (NY). HAMPDEN COUNTY: Granville, *Seymour 142* (NY). **Connecticut.** MORRIS COUNTY: Bantum Lake, *Rosalie 41* (NY). FAIRFIELD COUNTY: Bridgeport, *Eames* in 1895 (NY). LITCHFIELD COUNTY: Salisbury, *Druslar* in 1937 (NY). HARTFORD COUNTY: Burlington, *Enequist 21 & 27* (NY); Southington, *Bissell 148* (NY). MIDDLESEX COUNTY: East-Hampton, *Chamberlain* in 1924 (NY). WINDHAM COUNTY: Thompson, *Weatherby 4681* (NY). **Rhode Island.** WASHINGTON COUNTY: Westerly, *Moldenke 1620* (NY).

KENT COUNTY: Warwick, *Congdon* in 1878 (NY). **New York.** TOMPKINS COUNTY: Ithaca, *Coville US295392* (US); South Hill, Ithaca, *Allen* in 1934 (NY). SUFFOLK COUNTY: Long Island, Riverhead, *Latham 20504* (NYS); Long Island, Sag Harbor, *Latham 33287* (NYS); Long Island, Deer Park, *Latham 22380* (NYS). CORTLAND COUNTY: Valley of Fall Creek, *Allen* in 1934 (NY). ULSTER COUNTY: Lake Awosting, *Woodward* in 1938 (NY); High Falls, *Taylor 1821* (NY). HERKIMER COUNTY: Adirondack Mountains, Fourth Lake, Fulton Chain, *Killip 31802* (NY). GREENE COUNTY: Tannersville, *Vail* in 1891 (NY); New Baltimore, *Taylor 230* (NY). Catskill Mts., *Camp 3029* (NY). DELAWARE COUNTY: Stamford, *Taylor 592* (NY). ROCKLAND COUNTY: Palisades Interstate Park, *Lehr 720* (NY). ORANGE COUNTY: Black Rock Forest, *Raup 7220* (NY). SCHUYLER COUNTY: Hector, *Allen* in 1934 (NY). Shawangunk Mountains, *Woodward* in 1936 (NY). RENSSELAER COUNTY: Berlin, *House 24961* (NY). ST. LAWRENCE COUNTY: Morristown, *Phelps 763* (NY). **Pennsylvania.** BRADFORD COUNTY: Barclay Twp., State Game Lands #12, *Westerfield 1133* (NY). LYCOMING COUNTY: 3.5 miles S of So. Williamsport, *Fogg 17702* (NY). LENNOX COUNTY: Pocono Summit, *Porter* in 1891 (NY). SOMERSET COUNTY: Jenner Plateau, 2.5 km SSW of Tire Hill, Johnstonn, *Clausen & Shetler 236* (NY). SNYDER COUNTY: Selingsgrove, *Moldenke 3140* (NY). SCHUYLKILL COUNTY: *Parker* in 1864 (NY). ELK COUNTY: 1 mile E of Caledonia, *Wahl 623* (NY). PIKE COUNTY: Saw Hill Falls, *Nash* in 1909 (NY). LUZERNE COUNTY: Bear Run, *Taylor 2130* (NY). MONROE COUNTY: Pocono Plateau, Long Pond, *Britton* in 1893 (NY). CENTRE COUNTY: Thickhead Mt., *Mathias 1108* (NY). SULLIVAN COUNTY: Lake Ganoqua, *Smith* in 1902 (NY). **New Jersey.** MONMOUTH COUNTY: 1.5 miles ESE of Clarksburg, *Fogg 14112* (NY); Shark River, *Taylor 2292* (NY); 1 mile N of Holmeson, *Long 52029* (NY). ATLANTIC COUNTY: Mays Landing, *Pennell 12015* (NY); Atsian Road, Hammonton, *Bassett 89* (NY). MORRIS COUNTY: Succa-summa, *Mackenzie 3962* (NY). PASSAIC COUNTY: Greenwood Lake, *Mackenzie 2558* (NY). SUSSEX COUNTY: High Point, *Mackenzie 4182* (NY). **Virginia.** GILES COUNTY: vicinity of Mt. Lake, *Camp 3002* (NY). PAGE COUNTY: Luray, *Steele 124* (NY). PULASKI COUNTY: Peak Mt., along Peak Creek, *Small* in 1892 (NY). Shenandoah National Park, Hogback Mountain, *Camp 1289* (NY). **West Virginia.** GRANT COUNTY: Alleghany Plains, 20 miles W of Petersburg, *Batchelor* in 1940 (NY); Stony River Dam, *Core* in 1931 (NY). AUGUSTA COUNTY: Mt. Rogers, *Heller 823* (NY). PENDLETON COUNTY: Panther Mt., *Rydberg 9157* (NY). **Delaware.** East of Mt. Culea, Pyles Mill, *Commons* in 1875 (NY).